PEDIATRIC AIRWAY MANAGEMENT AND RESPIRATORY DISTRESS SELF STUDY MODULE

OVERVIEW

The following self study module was developed from sections of the Alaska Pediatric Prehospital Emergency Course. The course was developed by the Washington State Emergency Medical Services for Children Grant Project, using expertise from EMTs, paramedics, pediatricians, and EMS medical advisors. That course was then "Alaskanized" by adding or substituting information unique or appropriate to Alaska by EMS experts in Alaska for the Alaska State EMSC Grant Project.

This self study module is part of a continuing project by the Alaska State EMSC Grant Program to improve the flexibility of the delivery of this important educational material to EMTs and paramedics throughout Alaska. Information from the original course has been revised and updated as needed to reflect the new American Heart Association 2000 PALS guidelines. These sections of the Alaska Pediatric Prehospital Emergency Course have been formulated into a two-hour self study module designed to be a downloadable training unit from the state EMSC website.

Revised and edited by: Deborah Whitethorn, RN, EMT III, BSN

ACKNOWLEDGEMENTS

I would like to acknowledge:

American Heart Association. Guidelines 2000 for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care, *Circulation*, 2000; 102 (supplement).

Brain A, Denman W, Goudsouzian N. LMA Classic and LMA Flexible Instruction Manual, San Diego, CA: LMA North America, Inc., 2000.

Dieckmann R, Brownstein D, Gausche-Hill M, eds. American Academy of Pediatrics, Pediatric Education for Prehospital Professionals. Sudbury, MA: Jones and Bartlett; 2000

Emergency Medical Services for Children Program, EMSC Slide Set, EMSC 1997 for photograph contributions.

Foltin G, Tunik M, Cooper A, Markenson D, Treiber M, Phillips R, Karpeles T. TRIPP Teaching Resource for Instructors in Prehospital Pediatrics, New York, NY: Center for Pediatric Medicine; 1998 for providing drawings.

Girdwood Volunteer Fire Department members, Chief Bill Chadwick, Captain Matt Shields, Matt Olson, and Kristy Ulinder for photographic assistance.

Indiana Emergency Medical Services for Children Project, Prehospital Pediatric Care Provider Manual, Indianapolis, Indiana: Indiana Emergency Medical Services for Children.

Martha Moore, Injury Surveillance and Prevention Program Manager, Juneau, Alaska for updating the Alaska injury and death statistics.

Members of the Alaska State EMS Training Committee for their review and critique of these modules

I would also like to acknowledge those involved in the development of the original Washington State text:

Dena Brownstein, M.D., Sharon Monaghan, R.N., M.N., and Richard Bennett, R.N., R.E.M.T.P., editors. Washington State Emergency Medical Services for Children (EMSC) Project.

Washington State DSHS, Bureau of Parent-Child Health Services and the Section on EMS.

TABLE OF CONTENTS

CORE OBJECTIVES

Upon completion of this lecture, the EMT or Paramedic will:

1. Know that appropriate airway management is the key to success in pediatric resuscitation.
2. Know the clinical signs of respiratory failure.
3. Know the unique features of the pediatric airway and their implications for airway management.
4. List three common causes of upper airway emergencies in children and the clinical features of upper airway obstruction.
5. Know clinical presentation of lower airway obstruction.
6. List four signs of respiratory distress.
7. Describe appropriate field management of the child in respiratory distress based on level of consciousness.
8. Know that adequate oxygenation and ventilation must be ensured before transport is initiated.

CORE READING MATERIAL

IMPORTANT NOTE: All advanced level material in this section is presented in *italics*. Basic level providers will not be tested on this material.

AIRWAY MANAGEMENT AND RESPIRATORY DISTRESS

I. Etiology/Epidemiology

A. Anatomic features of the immature airway, age-related developmental issues, and infectious disease susceptibilities lead to increased risk for severe respiratory compromise in pediatric patients.

B. The majority of cardiopulmonary arrests in the pediatric age group are precipitated by a primary respiratory cause.

1. Primary cardiac arrest is rare in children. Hypoxemia and acidosis due to respiratory failure are the precursors of full arrest.
2. The leading cause of preventable death in pediatric emergencies – both medical and trauma – is failure to adequately manage the airway.
3. The airway is the key to success in pediatric resuscitation. Cardiovascular compromise can often be treated with oxygenation and ventilation alone.

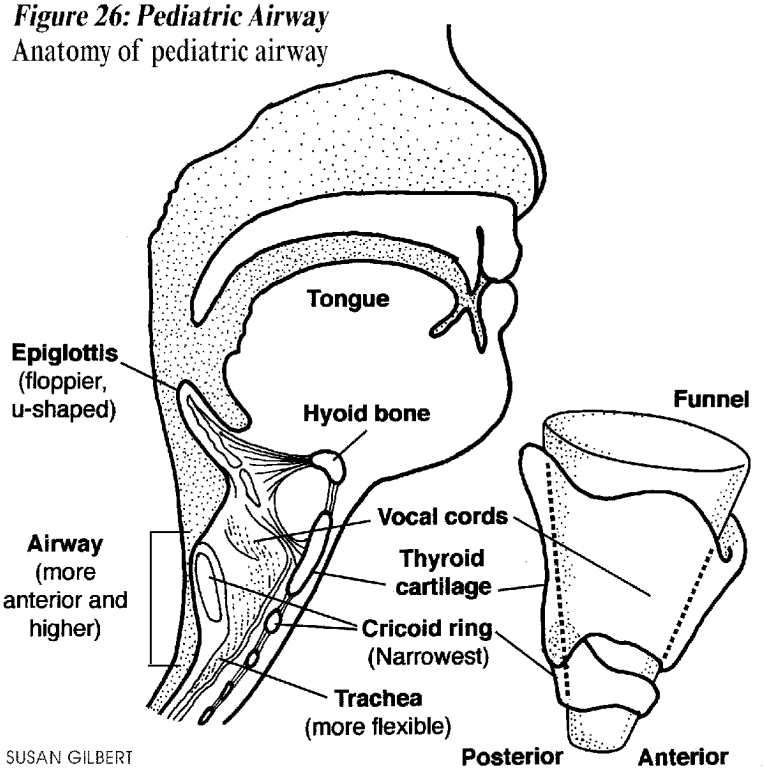
C. Respiratory Failure

1. Clinical state characterized by inadequate elimination of carbon dioxide and/or inadequate oxygenation of the blood
2. Seen as the end stage of respiratory distress of any cause or with inadequate respiratory drive (e.g. the patient with shallow respirations or apnea due to a head injury, seizure, or meningitis)
3. Respiratory failure is often preceded by a "compensated" state characterized by respiratory distress: use of accessory muscles, retractions, tachypnea and tachycardia.
4. Clinical signs of respiratory failure reflect inadequate oxygen delivery to the tissues and organs: decreased level of consciousness, tachycardia/bradycardia, weak proximal pulses, and poor skin perfusion.

D. Unique features of the pediatric airway

1. Tongue relatively large in proportion to oral cavity
   Most common cause of airway obstruction is loss of muscle tone with tongue falling back against posterior pharynx
2. Infants <2 months of age are obligate nose breathers.
   Nasal obstruction, as with mucous or blood, may result in severe respiratory distress.
3. Trachea is smaller and shorter than that of adults
   a. Smaller radius results in marked increase in resistance to air flow when edema or foreign body present
   b. *Trachea of newborn is approx. 5cm in length; 18 month old is approx. 7cm. Right mainstem intubation and accidental extubation common*.
4. Larynx is relatively anterior and high: C2 in neonate, C3-4 in child, C5-6 in adult. *Cords may be difficult to visualize during laryngoscopy.*
5. Smallest diameter of trachea is at the cricoid ring, below the cords, rather than at the vocal cords themselves.
   a. Endotracheal tube size dictated by caliber of subglottic trachea.
   b. Cuffed ET tubes are not used in children <8years – the narrow subglottic region produces functional seal and prevents air leak.
6. Chest wall of infants relatively weak and unstable
   a. Use of diaphragm leads to characteristic 'see-saw' or abdominal breathing pattern
   b. Intercostal, subcostal and suprasternal retractions are prominent as work of breathing increases with airway obstruction or lung disease
   c. Fatigue of respiratory muscles may lead to decreased respiratory effort as respiratory failure progresses
7. Immunologic immaturity leads to increased susceptibility to respiratory infections
   Croup, epiglottitis, and bronchiolitis are seen almost exclusively in young children.
8. Developmental immaturity leads to increased susceptibility to foreign body aspiration.

Figure 26: Pediatric Airway
Anatomy of pediatric airway

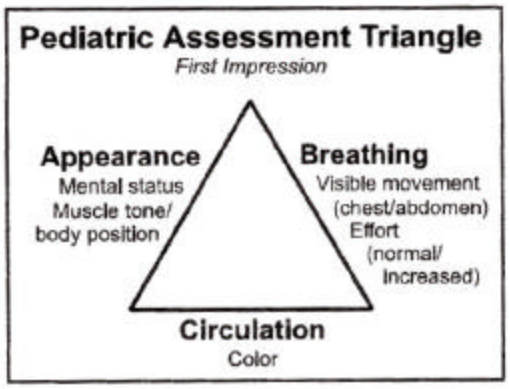


II. Field Assessment

A. After completing your scene size-up, the pediatric initial assessment begins with your general impression. This information is gained by observation. It is called the pediatric assessment triangle or PAT and includes three important components:

1. General appearance of the child – this includes the following observations:
   - Muscle tone and movement
   - Alertness/interaction with environment or caregiver
   - Crying or agitation that is inconsolable
   - Ability to speak or cry
2. Work of breathing (impression gathered before touching)
3. Circulation to the skin – includes your first impression regarding presence of pallor, mottling or cyanosis

The PAT, which is your general impression, allows you to immediately determine the severity of the child's illness or injury and assists you in determining the urgency for care.



B.` The next part of your field assessment after your general impression or PAT are the organized steps of the initial hands on physical exam, your ABCDE's. In the pediatric patient with respiratory distress there are some important things to consider which may alter your usual approach to the physical exam.

C. Agitation tends to make respiratory distress worse. Young children are often frightened of strangers and dislike being examined. Physical exam of the conscious child in respiratory distress should be limited to the essentials. As much information as possible should be obtained by observation. Always look before touching!

D. Respiratory distress may result from abnormalities anywhere in the tracheobronchial tree, lungs, pleura, or chest wall. Symptoms and signs of respiratory distress, regardless of etiology, may include:

1. Abnormal respiratory rate:
   a. Normal respiratory rate varies with age.

Age	**Normal Rate**
Newborn	30-60
6 months	25-40
1-3 years	20-30
6 years	18-25
10 years	15-20

   b. Rate is best assessed by observation – have parent expose child's chest while seated on their lap. Watch rise and fall of chest and abdomen.
   c. Rate > 60 is abnormal in child of any age.
   d. Abnormally slow rate is more worrisome than tachypnea and signals respiratory failure.
2. Increased work of breathing
   a. Retractions:
      1) Prominent sign in infants and young children due to thin, unstable chest wall.
      2) Intercostal, subcostal, and suprasternal retractions increase with progressive respiratory distress.

Infant with Retractions and Nasal Flaring

3) <u>Decreasing respiratory rate and diminished retractions in a child with history of distress signal severe fatigue and respiratory failure.</u>

b. Nasal flaring:
Seen with hypoxemia.

c. Grunting:
Expiratory noise made to generate positive end expiratory pressure (PEEP)

3. Altered mental status
   a. Agitation and irritability may indicate hypoxemia.
   b. Lethargy and decreased responsiveness may signal severe hypoxemia and/or carbon dioxide retention.
4. Color:
   Cyanosis is an unreliable sign of hypoxemia in children.
   Cyanosis reflects presence of critical level of deoxygenated hemoglobin. Children are relatively anemic and may not look blue until blood oxygen is dangerously low.
5. Position:
   a. "Sniff" position: Child seated with jaw thrust forward to maximally open airway.
      1) Seen with critical upper airway obstruction.
      2) Characteristic of epiglottitis.

Child in Sniffing Position

b. "Tripod" position: Child seated and leaning forward supported on outstretched arms to maximally utilize accessory muscles of respiration.
Seen with severe distress and increased work of breathing.

6. Cardiovascular status:
   a. Tachycardia commonly seen in child with respiratory distress.
   b. Bradycardia seen with severe hypoxemia and acidosis due to respiratory failure. Bradycardia in child with respiratory distress signals imminent cardiopulmonary arrest.

E. Localizing site of illness to upper or lower airway may assist in field treatment decisions.

1. History:
   a. Has the child had fever? For how long?
      1) Acute onset of respiratory distress in absence of fever suggests foreign body aspiration.
      2) Pneumonia, croup, and epiglottitis all have associated fever.
         a) Croup often has history of several days of low-grade fever (100.4-102.2 F, 38 – 39 C).

b) In epiglottitis, onset of respiratory distress occurs within 12 hours of appearance of fever.
c) Temperature in epiglottitis often >104.0 F, 40 C

b. Has the child had acute episode of coughing or choking suggestive of foreign body aspiration?

c. Will the child drink? Has he/she been drooling?
1) Difficulty swallowing suggests upper airway obstruction.
2) Fever and drooling points to epiglottitis.

d. Has the child's voice changed?
1) Hoarse voice suggests croup.
2) Muffled voice or refusal to talk suggests epiglottitis.

e. Has the child had similar problems in past?
1) Infants born prematurely often have chronic lung disease.
2) May have history of wheezing with colds and undiagnosed asthma.

f. Is the child a known asthmatic? On what medications? Last dose??

2. Auscultation of lung sounds:

Abnormal lung sounds may be difficult to appreciate under noisy conditions in the field. If adequate auscultation is possible, the following sounds may help localize site of illness:

a. **Snoring:**
1) Due to very proximal upper airway obstruction (tongue falling back against posterior pharynx).

b. **Stridor:**
1) High pitched noise heard on inspiration.
2) Due to upper airway obstruction (croup, epiglottitis, or foreign body).

c. Wheezing:
1) Heard most commonly on expiration.
2) Indicates lower airway obstruction (asthma, bronchiolitis).

d. Crackles:
1) Inspiratory noises; heard with parenchymal lung disease (pneumonia, bronchiolitis).

III. <u>Field Management:</u>

A. Early recognition of the need for life support in the child with respiratory distress is the goal of field assessment. Regardless of the underlying cause of respiratory distress, early intervention to correct inadequate oxygenation and/or ventilation is the key to a good outcome.

Cardiopulmonary failure is the final common pathway of inadequate tissue oxygen delivery, whatever the initial problem.

1. Prognosis following resuscitation from isolated respiratory arrest is excellent.
2. Prognosis following resuscitation from full cardiopulmonary arrest is grim, even if a perfusing rhythm is restored. Irreversible central nervous system damage has occurred when hypoxemia is sufficiently severe to precipitate cardiovascular collapse.

B. Your general impression or PAT, and in particular, the level of consciousness, should guide you in deciding the severity of the situation and in determining how aggressive your field treatment and interventions should be.

1. Agitation may precipitate worsening respiratory distress in the conscious child.
   a. Offer supplemental oxygen as tolerated.
   b. Infants and young children may not tolerate mask or nasal prongs. Allow parent to administer blow by O_2.

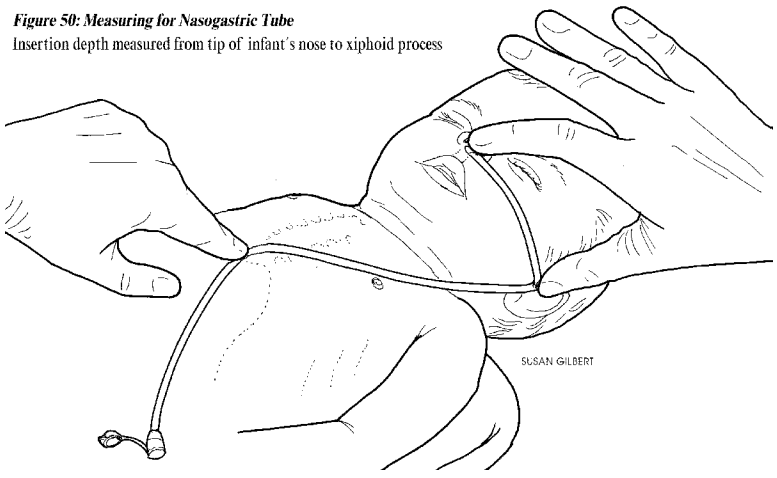
   c. Allow the responsive, conscious child to remain with parent. Monitor the child closely because he/she may deteriorate and you will need to be prepared to intervene more aggressively.
   d. Allow child to remain in position of comfort. Do not force child to lie down for exam or transport.
   e. *IV placement should not be undertaken unless clearly indicated.*

2. Impending respiratory failure should be suspected in a child with decreased level of consciousness. The child who is poorly responsive or unresponsive to the parent or caregiver needs aggressive intervention. This child should be removed from

parent's lap and have the airway status aggressively managed as follows:

a. Hypoxemia will initially cause agitation.
b. As hypoxemia worsens or severe CO_2 retention develops, child becomes less responsive and will ultimately lose consciousness.
c. Positive pressure ventilation should be initiated in the poorly responsive child with respiratory distress or in the child with cyanosis, gasping, or apnea unresponsive to supplemental oxygen.
    1) Open airway, using jaw thrust if C-spine injury suspected.
    2) Suction to clear the airway of blood, vomitus or visible secretions.
    3) Ventilate with pediatric bag-valve-mask device and 100 percent O_2.
        a) If spontaneous respiratory effort is present, attempt to coordinate assisted ventilations with child's own breaths.
        b) Appropriate rate will vary with age.
        c) Pop-off valve should be overridden (taped down) to allow delivery of adequate tidal volume when airway or lung disease present.
        d) Monitor chest rise to assess adequacy of tidal volume.
        e) Nasogastric tube should be placed to avoid gastric distension, vomiting and aspiration if prolonged BVM ventilation is needed.

Figure 50: Measuring for Nasogastric Tube
Insertion depth measured from tip of infant's nose to xiphoid process



.

4) *Child who does not respond to BVM ventilation with improved responsiveness, color, and pulse is not being adequately oxygenated and ventilated. Endotracheal intubation should be undertaken if clinical response is not rapidly seen.*
5) *Cardiac monitor should be applied if tolerated by child or if drug therapy undertaken.*

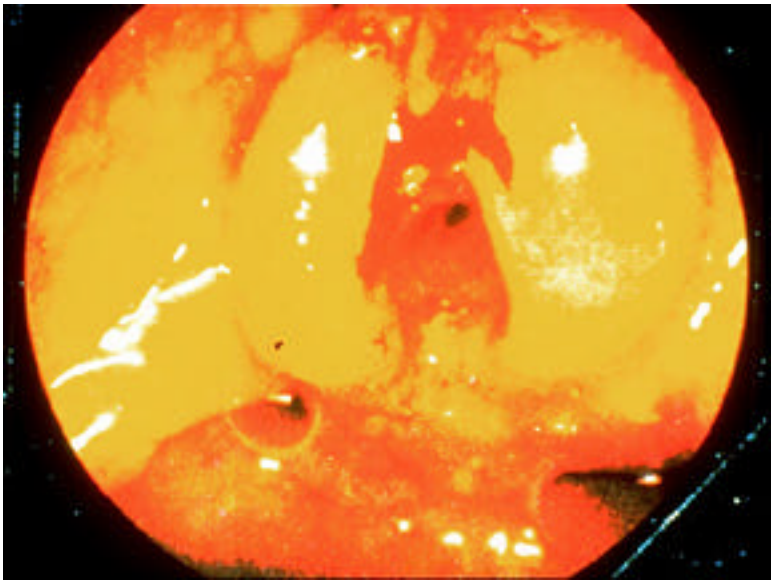
C. Common Pediatric Upper Airway Emergencies and Specific Management

1. The upper airway includes the oral and nasal cavities, pharynx, and trachea to the sternal notch.
2. <u>Croup Overview:</u>
   a. Viral infection causing edema of vocal cords and adjacent trachea. Results in partial upper airway obstruction.
   b. Accounts for approximately 90% of infectious upper airway problems in children.
   c. Occurs more commonly in winter.
   d. Children 6 months -3 years most commonly affected
   e. Clinical syndrome consists of cold symptoms and fever for several days, followed by respiratory distress, stridor, and barking cough.
   f. Symptoms often worse at night
   g. Course is subacute, and respiratory failure rare.
3. <u>Croup Management:</u>
   a. Cool, humidified air tends to alleviate obstruction associated with croup. Nebulized saline with no medication added can also be used to provide a cool water vapor to help reduce inflammation and swelling in croup.

b. *Racemic epinephrine 2.25% solution for inhalation:*
   1) *Dose: 0.5 cc in 4.5 cc NS nebulized.*
   2) *Administration of racemic epinephrine in field commits child to hospitalization due to rebound effect or at least a lengthy observation in the ED.*
   3) *Consult physician advisor for indications for use.*
   4) *Cardiac monitoring required due to tachycardic effect and potential for arrhythmias. Should be administered with supplemental O_2.*

c. *In rare situations, the child with croup may present in respiratory failure unresponsive to BVM ventilation. Only in this case would endotracheal intubation be required. An ET tube one or two sizes smaller than normal should be used due to the swelling and inflammation of the trachea at the subglottic level.*

4. <u>Bacterial Upper Airway Infection and Epiglottitis Overview</u>:
   a. Life-threatening bacterial infection causing inflammation and edema of the epiglottis and/or adjacent structures above the larynx.



Swollen Epiglottis

b. Epiglottitis is relatively rare due to widespread vaccination of infants against the bacteria Haemophilus influenzae, type B but there are other causes of upper airway infection.
c. More common in winter, but occurs year round.
d. Children are usually older than 12 months.

e. Onset is abrupt, with rapid progression to severe airway obstruction over hours
f. Fever, often up to 104 degrees Fahrenheit, 40 Celsius is generally the first sign and is present in almost every case
g. Sore throat or pain with swallowing usually present
h. As disease progresses, difficulty swallowing may lead to drooling and refusal to take fluids
i. Late in course, children may exhibit postural preference, which is assuming a seated position with jaw thrust forward – the 'sniff position' – to maximize air entry
j. Stridor may be present, but will not have the barking cough that is common with croup
k. Children tend to be very quiet and anxious
l. Complete obstruction and respiratory arrest will occur if definitive therapy not undertaken expeditiously. May be precipitated by agitation.

5. <u>Bacterial Upper Airway Infection and Epiglottitis Management:</u>
   a. Minimize interventions if child is conscious and maintaining own airway.
      1) Instrumentation of oral cavity with tongue blade or suction catheter may precipitate complete obstruction.
      2) Administer 100% O_2 only as tolerated.
      3) <u>Invasive procedures, such as IV placement, should not be performed unless lengthy transport is anticipated</u>.
   b. If child loses consciousness, becomes apneic, or develops persistent central cyanosis despite administration of 100% O_2, positive pressure ventilation is required.
      1) Most children with epiglottitis and "complete" obstruction can be bagged with bag-valve-mask.
         a) Excellent mask seal and high inspiratory pressures are required.
         b) Use a two person BVM technique and override pop-off valve.
      2) If BVM ventilation is unsuccessful, attempt intubation using an endotracheal tube 1-2 sizes smaller than anticipated for age.
         a) Chest compression by second rescuer may a force bubble of air through glottis and assist in identifying the cords.
         b) Aim the ET tube for the bubble of air.
      3) If patient cannot be intubated, needle cricothyroidotomy should be attempted if in the EMT/Paramedic's scope of practice.

6. Foreign Body Aspiration Overview
   a. Common complication of childhood
   b. Ages at highest risk: 6months – 5 years
      >90% of pediatric deaths due to foreign body aspiration occur in children <5 years old; 65% in infants
   c. Diagnosis suspected in any previously well, afebrile child with sudden onset respiratory distress and associated coughing, choking, stridor or wheezing
      <50% of children will have history of witnessed or suspected foreign body aspiration
   d. Severity and nature of symptoms varies with location of foreign body in respiratory tract

7. Foreign Body Aspiration Management
   a. Minimize field interventions if child is conscious and maintaining own airway.
   b. Administer 100% O_2 as tolerated.
   c. Mouth sweeps should not be attempted unless foreign body is visible and child's cooperation can be assured.
      Blind sweeps may lead to impaction of foreign body in glottis and complete obstruction.
   d. If wheezing present, foreign body is in a small airway and attempts to dislodge should not be undertaken in field.
   e. Tracheal foreign body causing complete obstruction, loss of consciousness, central cyanosis unresponsive to 100% O_2, or gasping respirations must be removed.
      1) If <1 year old, use back blows/chest compressions.
      2) If > 1 year old, use Heimlich maneuver.
      3) If foreign body not expelled by above, perform laryngoscopy and remove visible foreign body with pediatric Magill forceps.
      4) If foreign body not visualized, attempt to intubate and push foreign body into lower airway.
      5) If child cannot be intubated, needle cricothyroidotomy should be attempted if within EMT/Paramedic's scope of practice.

D. Common Lower Airway/Pulmonary Emergencies and Specific Management

1. Asthma Overview

a. Disease characterized by hyper-reactive small airways and reversible obstruction of those airways.
b. Three components of obstruction: bronchoconstriction, mucosal edema, and increased secretions.
c. Most common pediatric chronic disease.
d. Attacks precipitated by variety of causes – infections, allergies, cold, exercise, stress.
e. Characterized by wheezing, cough and increased work of breathing.
f. Children in severe distress may assume 'tripod' position, leaning forward on hands to facilitate use of accessory muscles of respiration.
g. With severe obstruction air entry may be so compromised that wheezing disappears, so called 'quiet chest' signaling impending respiratory failure.
h. Severity of symptoms varies widely from mild distress to respiratory arrest.

2. Bronchiolitis Overview

a. Viral infection causing obstruction of lower airways and symptom complex similar to asthma.
b. Most common in children <2 years old.
c. Epidemics occur in winter months.
d. The respiratory syncitial virus (RSV) is responsible for over 50% of the cases.
e. Characterized by diffuse crackles, wheezing, and increased work of breathing, with tachypnea, nasal flaring, and retractions.
f. Apnea is a complication seen primarily in young infants.
g. Infants with pre-existing cardiopulmonary disease have an increased incidence of death related to RSV infection.
h. Unlike asthma, obstruction is poorly responsive to bronchodilator medications.

3. Asthma/Bronchiolitis Management

a. Administer supplemental O_2.

b. *A severe asthma attack can be treated with bronchodilator drugs.*

1) Nebulized therapy:

a) May be better tolerated than SQ epi, especially by older children.

b) May be administered by blow by to infants too young to accept mouthpiece.

c) Sympathetic side effects (tachycardia, tremor, nausea) less pronounced than seen with epinephrine.

d) Albuterol (Proventil), 0.5% or 5 mg/ml solution for inhalation, can be given as follows:
<15 kg: 2.5 – 5.0 mg (0.5-1.0ml) diluted in 3 ml of normal saline, nebulized. May repeat q 20-30 minutes X 2 or use continuously in critical patients.
>15 kg: 5-10 mg (1-2ml) diluted in 3 ml of normal saline, nebulized. May repeat every 20-30 minutes X 2 or use continuously in critical patients.

2) Albuterol metered dose inhaler
4 to 8 puffs every 20 min X 3 doses, administer with mask or spacer device.

3) All bronchodilator drugs may cause tachycardia and arrhythmias.

a) Consult physician advisor prior to administration if heart rate >180.

b) Continuous cardiac monitoring required when bronchodilators administered in field.

c. If a wheezing child cannot tolerate nebulized or inhaled drug therapy or is not moving enough air to inhale the drug properly, give SQ epinephrine.

Epinephrine: 0.01 cc/kg 1:1000 solution SQ in the deltoid muscle or anterior thigh of infants; maximum dose = 0.3 cc; may repeat q20-30 minutes X 2.

d. *Consider BVM ventilation and ET tube intubation only if the child is in respiratory failure and has failed to respond to high-flow oxygen and maximal bronchodilator therapy.*

4. Bronchopulmonary Dysplasia (BPD)

   a. Seen in infants who were born prematurely. It is an example of a chronic disorder that develops in premature infants as a result of the therapies used to treat their immature lungs.
   b. Prolonged exposure to high oxygen concentrations, endotracheal intubation, ventilator pressures and fluid overload damage the pulmonary tree. These infants are medically fragile and susceptible to respiratory infections.
   c. These infants normally expend considerable energy to breathe and are frequently on home oxygen and multiple medications. In addition, they may have delay in normal growth and development due to their prematurity or have significant disabilities such as cerebral palsy, mental retardation, deafness and blindness.
   d. Characterized by chronic respiratory distress. May have retractions, crackles, and wheezing and supplemental oxygen requirement at baseline.
   e. There is a high mortality rate in the first year of life and parents are often extremely anxious.
   f. These are medically fragile children who have minimum respiratory reserve and can be at risk from even a minor infection. They may decompensate quickly and may require increased oxygen and airway ventilation interventions, and bronchodilator medications per physician recommendations.

E. Transport

1. Transport should be undertaken expeditiously. However, a stable airway and adequate oxygenation and ventilation should always be ensured before transport is initiated. "Scoop and run" has no place in the management of a child in respiratory failure.
2. Frequent reassessment for signs of deterioration must be performed and appropriate action taken as problems are identified.
3. Early notification of the receiving hospital should be performed.
4. BLS units should consider ALS rendezvous if child unstable.

CASE STUDIES RELATED TO AIRWAY MANAGEMENT AND RESPIRATORY DISTRESS

CASE ONE

Becky is a two year old toddler with difficulty breathing and wheezing. Her mother says she had this wheezing happen once before about 6 months ago, which cleared up with a breathing treatment. Becky is alert and active. She is breathing fast, with labored respirations, nasal flaring, and intercostals retractions. Her color is slightly pale and her capillary refill is 2 seconds. Her pulse is 132 per minute, her respirations are 48 breaths/minute, her blood pressure is 90/60 mm Hg, and her axillary temperature is 97.8 F.

What should your initial approach and interventions be for this child??

Answer:

This child is having respiratory distress and evidence of lower airway wheezing, not upper airway stridor. She remains alert and active, however, so she should remain with her mother in her preferred position of comfort. She should be watched closely for signs of deterioration. Interventions should be limited to only what is necessary to minimize agitation, which increases respiratory distress. No IVs should be attempted. Administration of oxygen should be attempted in whatever way is tolerated without increasing agitation. This may mean having the mother administer blow by O_2. Administering albuterol by nebulizer can be attempted with mother's assistance in gaining the cooperation of the child, using the technique described in the procedure section of this module. The child requires transport to the hospital.

CASE TWO

You are called to the scene of a 6 month old infant in respiratory distress. He has had a fever of up to 102.3 F for 2 days and has a cough and runny nose. The father has given Tylenol 30 minutes ago. The infant is alert and active. His eyes are following what you or the caregiver does. He smiles at his mother and makes eye contact. He has good color and muscle tone. He has a frequent barking cough and slight stridor when he is not at rest. At rest the stridor disappears. There are very mild retractions and no wheezing, but rales are heard in both bases. The skin is warm with good pulses and capillary refill of 2 seconds. The HR is 170/min and respirations are 50/min.

What should your initial approach and interventions be for this child??

Answer:

This infant is in minimal respiratory distress with slight retractions. The stridor suggests minor upper airway obstruction. Since there has been a gradual onset of fever and illness over two days, this suggests viral croup. Because the child is alert and normal in appearance, he needs to remain in close contact with his mother in his preferred position of comfort during transport. Agitation should be minimized to reduce his stridor and respiratory distress. 100% oxygen by blow by can be offered as tolerated and nebulized cool mist saline may be given enroute.

CASE THREE

You are called to the scene of a 15 month old infant in respiratory distress. He developed wheezing early in the morning and worsened through the day. According to mom, he is not taking fluids and not eating since early this morning. You observe that he is lethargic and poorly responsive. He allows you to examine him without complaint. His color is poor and his face appears somewhat cyanotic. His skin is cool and capillary refill time is 3-4 sec. He has significant increased work of breathing with retractions, grunting, and nasal flaring. There also appears to be periods when he stops breathing altogether. Vitals are: HR 210/min, RR 90/min, and BP 90 palp.

What should your initial approach and interventions be for this child??

Answer:

This child is critically ill and in late respiratory failure. He requires immediate and aggressive ventilatory support before respiratory arrest occurs. He needs to be removed from Mom's arms, exposed, positioned properly, and ventilated aggressively with BVM. Avoid gastric distension by inflating the lungs just enough to make the chest rise. If prolonged bagging is required, insert an NG tube. If bradycardia develops or if BVM does not improve color, tone, and level of consciousness, consider intubation. Transport immediately.

RELATED PEDIATRIC PROCEDURES

Basic Airway Adjuncts Overview

I. General principles:

A. Supplemental oxygen should be administered to every child in respiratory distress, in the highest concentration available.
B. Supplemental oxygen is the only airway intervention needed if a child is breathing spontaneously and appears to be ventilating adequately.
C. Agitation may precipitate worsening respiratory distress/airway obstruction. Minimize intervention in the conscious child who is maintaining his/her own airway. When possible, allow the child to remain with a parent.
D. Certain positions maximize airway patency and respiratory effort. Allow the child in respiratory distress to maintain his/her position of comfort (e.g., allow the child to be transported in the seated position if he/she appears to favor it).

II. Oxygen Delivery Systems:

A. Blow-by oxygen administration:

1. Conscious infants and toddlers may become very agitated when oxygen delivery devices (masks, nasal cannula) are placed on their face. Agitation may worsen respiratory distress. In such cases, allowing a parent to administer blow-by O_2 by holding the hose or mask near the child's face may be the most effective way of delivering supplemental oxygen. A convenient method is to place O_2 extension tubing through the bottom of a styrofoam cup.

Figure 7: Blow-by Oxygen, Child
Placing oxygen tubing in paper cup decreases child's anxiety

B. **Nasal cannula**:

1. Available in infant, child and adult sizes.
2. Not capable of delivering high oxygen concentrations, typically 25-40%
3. May be taped to the cheeks of an uncooperative infant or toddler who is attempting to remove it! If presence of device is causing agitation, consider switching to blow-by.
4. It is <u>not</u> the device of choice in most prehospital situations.

C. **Oxygen masks:**

1. Oxygen masks may frighten young children who feel suffocated by having their nose and mouth covered. In pre-school aged children, make the analogy between the oxygen mask and a space mask and let them be a spaceman or astronaut. This game may enhance cooperation and decrease agitation. In the unconsolable child, consider blow-by as an alternate route.

2. Choose oxygen mask based on O_2 concentration desired:

   a. Simple oxygen mask: Low-flow device that will deliver — 35 to 60 percent oxygen with a flow rate of 6-10 L/min.

   b. Partial rebreathing mask: Simple face mask with an added reservoir bag. Provides reliable inspired oxygen concentration of —50-60 percent.

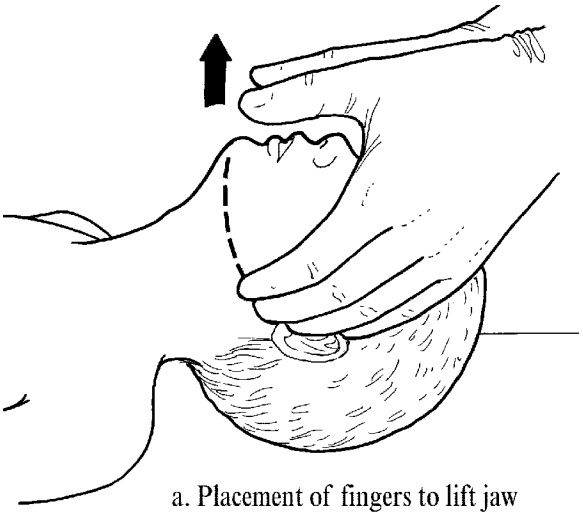
   c. Non-rebreathing mask: Valves incorporated into the exhalation ports to prevent entrapment of room air during inspiration, and a valve placed between the reservoir bag and mask to prevent gas flow back into the bag from the mask during exhalation. On inspiration the patient draws 100 percent oxygen from the reservoir and the fresh oxygen inflow. Oxygen flow into the mask is adjusted to prevent collapse of the bag. An inspired oxygen concentration approaching 95 percent can be achieved with an oxygen flow of 10-12 L/min and well-sealed face mask.

Ill. Methods for Opening the Airway:

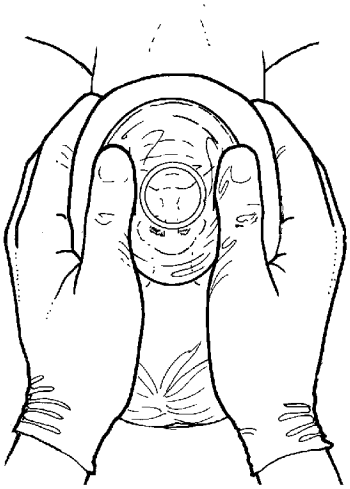
A. Non-invasive airway management techniques are useful in the spontaneously breathing patient, or to facilitate ventilation during rescue breathing.

1. Indications and techniques are similar to those in adults.
   a. Jaw thrust, without head tilt, is the proper technique for opening the airway if C-spine injury is suspected.

Figure 38: Modified Jaw Thrust



a. Placement of fingers to lift jaw



SUSAN GILBERT

b. Placement of hands on mask

b. Chin lift:
   1) Avoid hyperextension of the neck, especially in young infants. Hyperextension may lead to collapse of the soft, immature trachea and worsen obstruction.
   2) Care must be taken to place fingers under bony part of lower jaw in performing chin lift. Compression of the soft tissues under the chin will lead to displacement of support structures and tongue into oropharyngeal area and tracheal compression in the infant.
   3) Newborns and young infants have very large occiputs, causing them to be hyperflexed when lying on a stretcher or backboard. Placing a small towel or diaper roll under their shoulders will bring them into neutral alignment.

4) Obtain sniff position in the child by gently tilting head back with hand on forehead or by placing a small towel under the occiput.

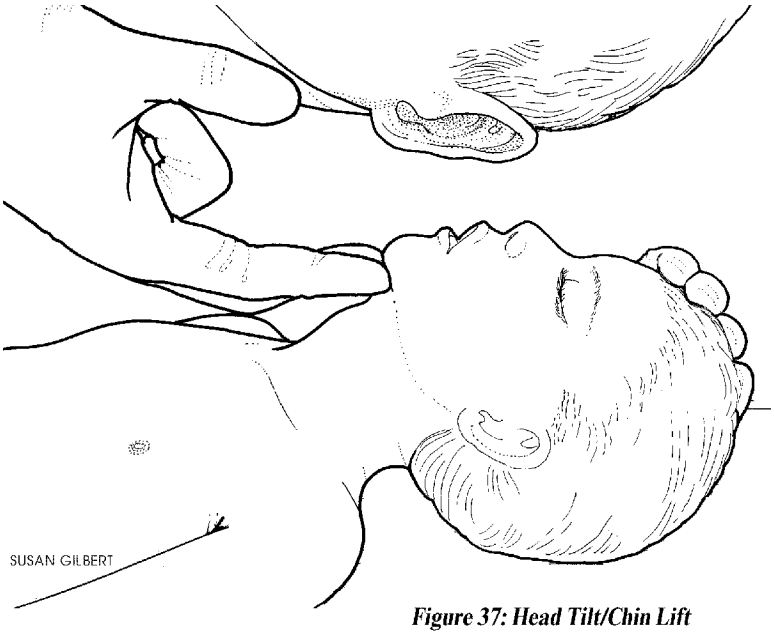


Figure 37: Head Tilt/Chin Lift

IV. Suction:

A. Suction may be necessary for clearing secretions or vomitus from the oral cavity or nares of a child in order to maintain a patent airway. Suctioning is likely to produce agitation in the conscious child, and risks and benefits must be weighed.

1. Suctioning is contraindicated in the conscious child with suspected epiglottitis or foreign body aspiration, as it may precipitate increased obstruction.
2. Other complications of suctioning include:
   a. Hypoxemia--due to prolonged suctioning;
   b. Bradycardia--due to hypoxemia or vagal response;
   c. Increase in intracranial pressure;
   d. Gagging, emesis, and aspiration;
   e. Nose-bleed, if deep nasal suctioning is performed.
3. Administer 100 percent O_2 before and after suctioning. Suctioning episodes should be limited to 5 seconds to avoid hypoxemia and bradycardia. Heart rate must be monitored during suctioning. If rate drops below normal value for age, stop suctioning immediately and oxygenate and ventilate patient.

B. Suction Devices:

1. Bulb syringe: Commonly used to clear nose and mouth of secretions, blood, meconium in newborn delivery.
2. Tonsil tip suction device (Yankauer): Useful for the removal of thick secretions and particulate matter from the pharynx; should be at hand for field intubations.
3. Flexible suction catheter: Age-appropriate catheter size (5, 8, 10 or 1 2 French) may be used for deep nasal or endotracheal tube suctioning. May also be used to suction thin oral secretions. As a general rule, the suction catheter size is a number twice that of the ET tube size. Example: a number 10F suction catheter would fit into a number 5 ET tube.

V. Oropharyngeal Airways:

A. With correct positioning, most children can be ventilated without the use of an artificial airway. Use of oral airways is limited to unconscious children with absent gag reflex.

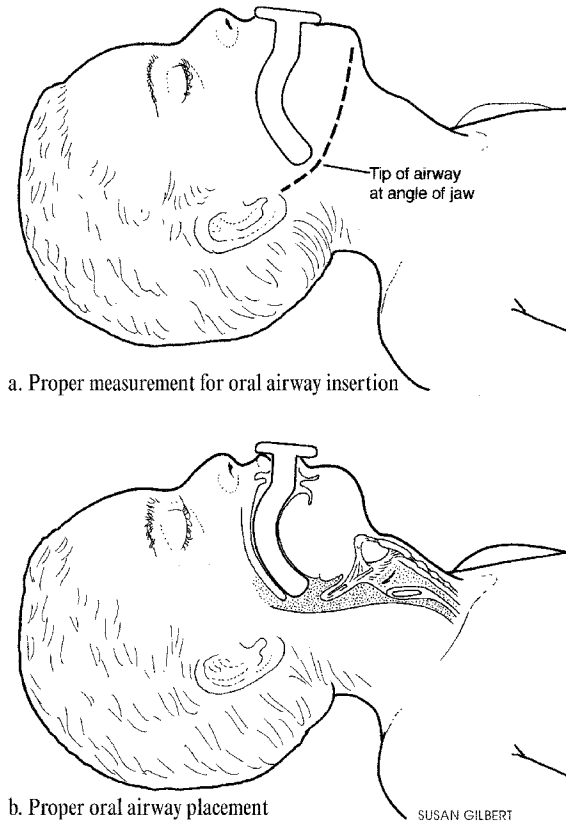
1. Loss of oropharyngeal muscle tone in the unconscious child leads to proximal airway obstruction with the tongue. This may be relieved, and bag-valve mask ventilation facilitated, by oral airway placement.
2. Placement in a conscious child, including most patients who are seizing or post-ictal, induces gagging and vomiting, with risk of aspiration. Airway placement must not be attempted in such patients.

B. Proper function of oral airway requires choice of age-appropriate device.
1. Airway length should equal distance between mouth and angle of the jaw--too small or too large an airway may worsen obstruction.

C. Insertion Technique:

1. In older children (>1 year): May be inserted upside down and rotated once tip is in posterior pharynx.
2. In infants (<1 year): Insert directly with use of a tongue depressor. Placement by rotating, as in children and adults, may lead to injury to soft palate.

Figure 32: Oral Airway Insertion



Oral Airway Insertion

VI. Combitube Airway or Esophageal Obturator Airway (EOA):

Designed for use in adult patients. EOAs have no place in airway management of children or adolescent under 16 years old.

VII. Bag-Valve-Mask Ventilation:

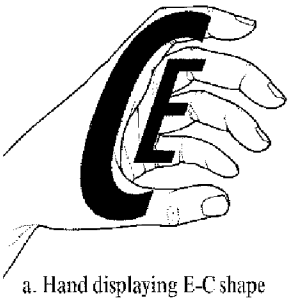
A. Bag-valve-mask ventilation of pediatric patients requires age-appropriate equipment and excellent technique. Demonstration of skill on infant and pediatric manikins should be part of BLS airway certification and recertification programs.

1. Every ambulance should have a 500 cc pediatric resuscitator (self-inflating bag-valve-mask device) and consider stocking a 250 cc infant resuscitator.
    a. Always use oxygen reservoir with self-inflating resuscitator.
    b. Infant and pediatric resuscitators have pop-off valves which activate at about 40 mmHg. Pop-off valve activation may prevent delivery of adequate tidal volume, and will decrease concentration of inspired oxygen delivered. Bypass pop-off manually or tape down to inactivate.
2. The pediatric kit must include masks that will fit children from birth through adolescence. A good seal is most easily achieved with masks with soft, inflated cuff.

B. BVM Technique

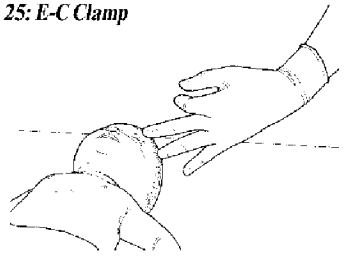
1. If no signs of trauma are present, tilt the child's head back to open the airway. If trauma is suspected, do not move the head.
2. To open the airway, lift the jaw, using the last 3 fingers of one hand. Position these 3 fingers under the jaw as this may occlude the airway.
3. Put your thumb and forefinger in a "C" shape over the mask and exert downward pressure on the mask. This hand position is called the "E-C clamp technique. Use the thumb and forefinger to squeeze the mask onto the face while the remaining fingers (forming the "E") of the same hand lift the jaw and pull the face toward the mask. This should create a tight seal.

4. The EC clamp technique is the recommended method of achieving a good mask seal.

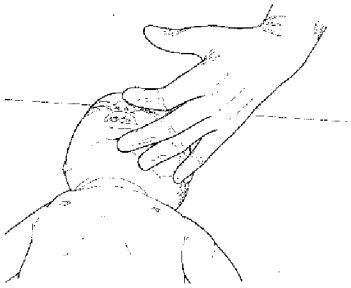


a. Hand displaying E-C shape

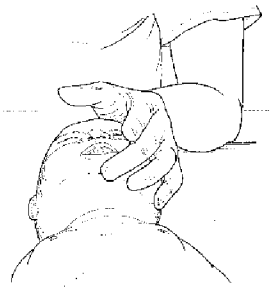
Figure 25: E-C Clamp



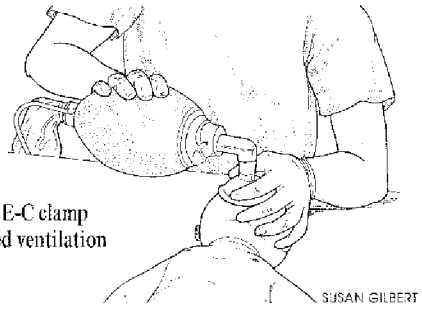
b. E formed with small, ring, and middle fingers; C formed with index finger and thumb



c. E fingers resting on bony ridge of jaw



d. C fingers positioned to hold mask



e. Proper E-C clamp for assisted ventilation

SUSAN GILBERT

5. Once you have correctly applied the mask, compress the BVM with the other hand until the chest rises.

6. Gentle cricoid pressure applied by another rescuer may be necessary to reduce gastric inflation and risk of aspiration during bagging. It is used only in the unconscious victim. Do not use excessive pressure on the cricoid cartilage in the child or infant; only one finger is necessary in the young child or infant.

7. Two-rescuer technique may be essential in children with difficult airways (e.g., epiglottitis or foreign body aspiration with complete obstruction).

C. Assess adequacy of BVM ventilation:

1. Evaluate chest rise and presence of bilateral breath sounds
2. Evaluate clinical response including increased heart rate and return of good color
3. Use only the force and tidal volume necessary to cause the chest to rise. Excessive volumes may compromise cardiac output, distend the stomach, increase risk of regurgitation and aspiration, and increase risk of barotraumas.
4. If you have poor chest rise with bagging with a BVM, quickly evaluate the following:
   a. Reposition the mask
   b. Check the O_2 source and that it is attached to the bag
   c. Do you have an oral airway in place?
   d. Use Sellick maneuver to decrease abdominal distension.
   e. Assess need for a nasogastric tube to decompress the stomach and protect against aspiration.
   f. Assess need for higher pressures and need to override the pop-off valve.
   g. Check for presence of a foreign body

D. *Nasogastric/orogastric tubes:*

1. *Prolonged positive pressure ventilation in infants and young children leads to gastric distention. This leads to difficulty in ventilation due to impaired diaphragmatic excursion, and increased risk of vomiting/aspiration.*
2. *NG/OG tube placement should be considered if BVM ventilation is to be continued during transport.*

VIII. Oxygen powered breathing devices should not be used in pediatric patients.

High inflating pressures delivered with such devices will result in gastric distension and may cause serious pulmonary damage in children.

Advanced Material -Endotracheal Intubation

I. General Principles:

Endotracheal intubation should be attempted only by highly-trained medical providers who maintain their skill levels through experience or frequent retraining. Demonstration of skill on infant and pediatric manikins should be an integral part of classroom training.

A. Indications for field intubation of the pediatric patient include: inability to oxygenate/ventilate via bag-valve-mask; prolonged transport time and ongoing need for assisted ventilation; need for tracheal suctioning; need for access route for resuscitation medications.

B. Risks of intubation are similar in pediatric and adult patients.

Infants become hypoxemic more quickly than adults when deprived of oxygen. EMS personnel must be especially conscious of duration of intubation attempts in pediatric patients and ensure adequate pre-oxygenation via BVM prior to each attempt.

II. Equipment:

Safe and successful intubation requires age-appropriate equipment.

A. Infants are most easily intubated using a straight laryngoscope blade. A straight or curved blade may be used in children, according to paramedics experience and degree of comfort with the equipment. Blade size is chosen according to age.

B. Endotracheal tubes:

1. Tube size is dictated by age. Size can be approximated by choosing tube equal to diameter of child's little finger or nostril. Tube of one size bigger and one size smaller should be at hand.

2. Cuffed tubes are not used in children under 8 years of age, due to differences in airway anatomy. In these children, the cricoid ring is the narrowest portion of the airway and acts as a natural cuff.

3. Intubation of infants, using small floppy tubes, may be facilitated by use of a stylet to guide the tube through the cords. Care should be taken that tip of stylet is at least a centimeter proximal to the tip of the tube (to avoid tracheal damage).

ENDOTRACHEAL INTUBATION TABLE

AGE	ET Tube Size	Depth of Oral Intubation (cm)	Blade Size	Suction Catheter
Premature,				
newborn	2.5-3.0	6 + weight (kg)	0	5-6 F
Term newborn	3.50	6 + weight (kg)	1	6 F
6 months	3.50	11	1	8 F
l year	4.00	11	1	8 F
3 years	4.50	13	2	8-10 F
5 years	5	14	2	10 F
6 years	5.5	15	2	10 F
8 years**	6	17	2	10-12 F
12 years	6.50	19	3	12 F
16 years	7	20-24	3	12 F
Adult Female	7.50	22-24	4	12 F
Adult Male	8	22-24	4	14 F

**Utilize only uncuffed ET tubes under age 8

III. Intubation Drugs:

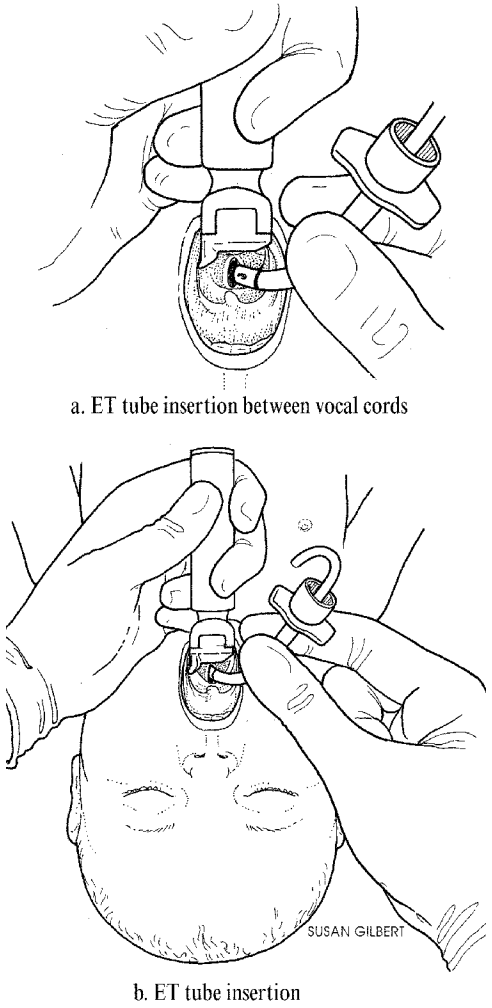
The use of neuromuscular blockade drugs will be dictated by local protocol, your EMS program director, and the situation at hand.

A. Commonly used agents include succinylcholine (Anectine) and pancuronium (Pavulon). The use of succinylcholine in young children, especially with repeat doses, may be associated with profound bradycardia. For that reason, pretreatment with atropine is recommended when Anectine is to be used.

B. Doses:
   1. Atropine: 0.02 mg/kg IV or ET with a minimum dose of 0.1 mg
   2. Succinylcholine: 1 mg/kg IV or 4mg/kg IM
   3. Pancuronium: 0.1 mg/kg IV

IV. Intubation Technique:

Figure 30: Intubation, Detail



a. ET tube insertion between vocal cords

b. ET tube insertion

Although basic skills are the same in adult and pediatric intubation, differences in anatomy and landmarks exist:

Have equipment/suction ready - check equip.
- Suction – yankuaer
- Suction catheter
- BVM
- Stylet
- 3 tubes – one size smaller and larger
- Blade/handle
- CO_2 detector
- Tape, tube holder

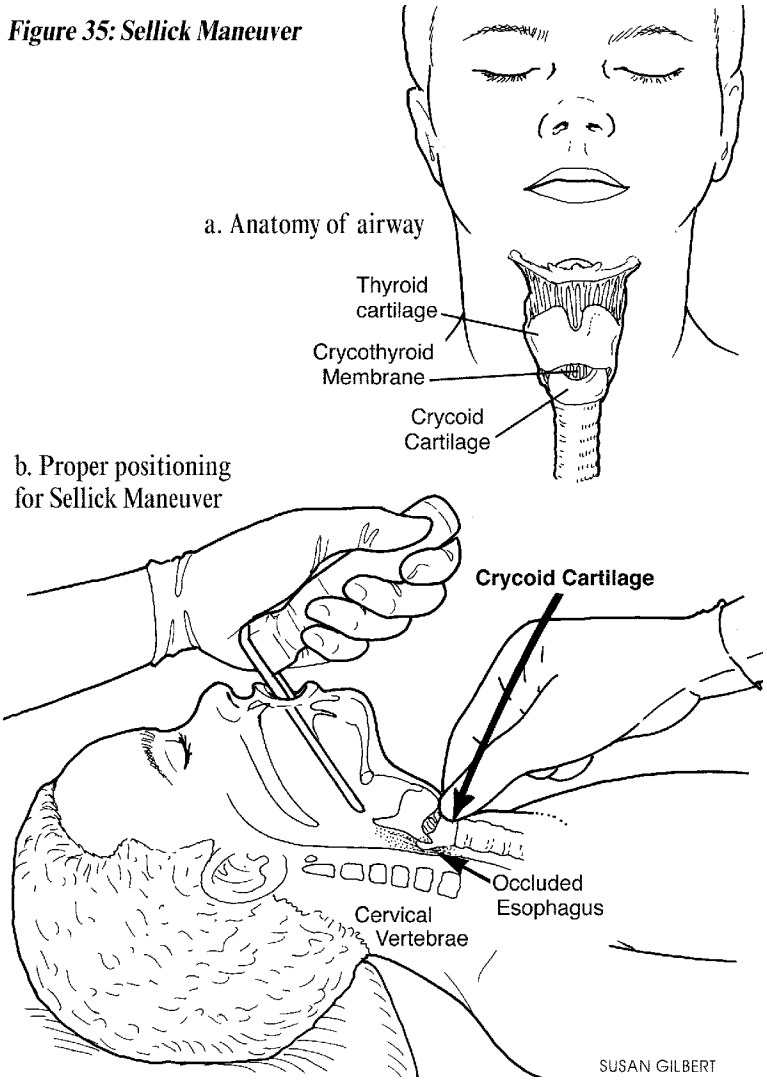
Everything is smaller! If no recognizable landmarks are seen when blade is inserted, it is probably in the esophagus.

Blade is inserted on right side of mouth and tongue is swept to the left. Lift the tongue to lift the epiglottis. Withdraw slowly and watch for cords to come into view.

A. Cricoid pressure (Sellick maneuver) is sometimes used to enhance visualization of cords, which may be difficult due to their anterior placement in young children.

1. Performed by applying gentle pressure to the anterior trachea at the level of the cricoid ring, compressing the esophagus behind it. Use one finger for infants; thumb and index finger on children. Avoid excessive pressure.
2. Technique may also be used to decrease gastric distention during BVM ventilation, since tracheal pressure causes collapse of the esophagus.
3. Cricoid pressure should be used with caution in young infants where it may cause tracheal compression/obstruction due to incomplete formation of cartilaginous tracheal rings.

Figure 35: Sellick Maneuver

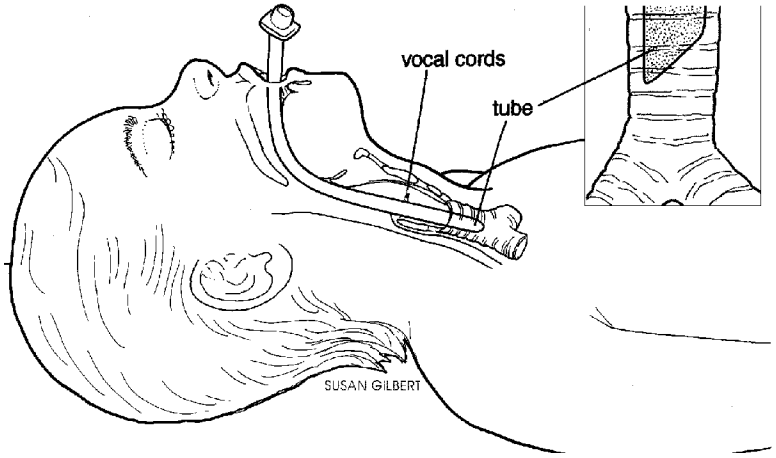


B. Young children become hypoxic rapidly. Limit each intubation attempt to 20 seconds, and preoxygenate with 100 percent 0_2. Heart rate must be monitored during intubation attempts, as hypoxia rapidly leads to bradycardia in children.

C. Do not force a tight tube. The narrowest part of the child's airway is <u>below</u> the cords.

D. Watch as tube is advanced, as the airway is short and mainstem bronchus intubation is a common complication. The tip of an uncuffed tube should be 2-3 cm below cords. Pediatric tubes have three sets of rings marking their distal end. If the second ring is at the level of the cords, the tube is in mid-tracheal position. Tube position can also be assessed by centimeter marking at the lips.

Figure 34: Positioning of Endotracheal Tube
Proper ET tube placement in airway



V. Confirming Endotracheal Tube Placement

Once you have the child intubated, hold the tube firmly at the level of the lip and evaluate placement:

A. Primary Tube Confirmation:

1. Provide positive-pressure ventilation and observe for bilateral, symmetrical chest rise. Remove the tube if there is no chest rise with ventilation.

2. Listen for gurgling over the epigastrum which indicates esophageal intubation. Breath sounds should be absent over the upper abdomen but in a small child it may be transmitted sounds from the lungs. Remove the tube if you also see noticeable gastric distention with ventilation.

3. Listen for equal breath sounds bilaterally over the peripheral lung fields and in the axillary areas indicating proper tube placement in the trachea. If breath sounds are equal, secure the tube. If louder on the right side, then slowly pull back the ET tube until breath sounds are equal as it may be in the right mainstem bronchus, then secure the tube.

4. Observe the child for signs of clinical improvement such as improved color, perfusion, and oxygen saturation.

B. **Secondary Tube Confirmation**: – recommended **mandatory** by American Heart Guidelines

1. Secondary tube placement confirmation should be done with an end-tidal CO_2 detector or capnography in a child with a perfusing rhythm. It is not useful for the child in cardiopulmonary arrest because CO_2 may not be detected even when the tube is correctly placed in the trachea because of a lack of pulmonary circulation.

2. Use a pediatric CO_2 detector for a child who weighs less than 15 kg but more than 2 kg. Use an adult CO_2 detector if the child weighs 15 kg or more. DO NOT use an adult device on a child less than 15 kg. A color change from purple to yellow should be observed on exhalation after a total of 6 breaths indicating proper placement of the tube.

Figure 36: Ventilation through Endotracheal Tube

3. Esophageal detector bulbs or syringes may be used in children who weigh more than 20 kg. After attaching the device to the end of the ET tube, aspirate slowly over 3-5 seconds. If resistance is felt during aspiration, then the ET tube is in the esophagus. If air is aspirated, the ET tube is in the trachea. These devices are useful in pulseless patients.

Note: The child who remains cyanotic and bradycardic despite bagging should have his ET tube reassessed for position and patency. Bradycardia in children is almost always due to hypoxia.

C. Troubleshooting ET tube problems

If the condition of the intubated child deteriorates, consider several possibilities which can be remembered by the mnemonic **DOPE:**

D Displacement of the tube from the trachea

O Obstruction of the tube

P Pneumothorax

E Equipment failure

Possible Problems:

- Esophagus intubation
- Disconnected O_2 or malfunctioning bag
- R mainstem intubation
- Kinked tube
- Poor lung compliance
- Occluded w/secretions
- Pneumothorax - deviated PMI, resistance to bagging, needle R side

VI. Securing the Endotracheal Tube

A. Secure tube carefully. The infant or young child's airway is short, and a small amount of displacement can lead to mainstem bronchus intubation or accidental extubation, even if the tube was initially placed correctly.

Accidental extubation most commonly occurs during loading or unloading patients from ambulances or other transport vehicles or stretchers.

B. In older children, it is preferred to secure the tube with a commercially made ET tube holder device of an appropriate size rather than tape.

C. In younger children and infants with small tubes, taping to secure the tube is necessary:

1. Insert a correctly sized oral airway as a bite block, making sure not to compress the tube.

2. Cut two pieces of 1 inch wide tape approximately 6 inches in length. Cut or tear the pieces in half lengthwise for approximately 4 inches (leave a 2 inch length of tape that remains the full width.).

3. Apply the intact piece of adhesive tape to the cheek and adhere one length of the torn portion across the upper lip.

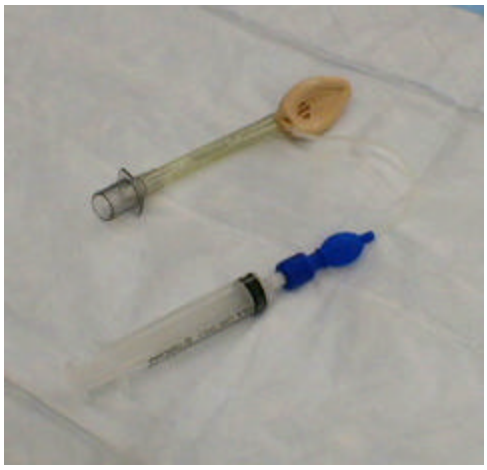
4. Wrap the second length of the torn portion around the tube at least two to three times.

5. Apply the second strip in a similar fashion from the opposite direction.

6. All pediatric intubated patients should have a C collar on to protect the ET tube placement during transport.

D. Document the location of the ET tube at the lip or gum line. Reassess tube position continuously.

LARYNGEAL MASK AIRWAY



Description:

The Laryngeal Mask Airway is an airway management device intended as an alternative airway to face mask use. It is composed of a tube with a cuffed mask-like projection at distal end. The mask is designed to conform to the contours of the hypopharynx with its lumen facing the laryngeal opening. It is not inserted into the trachea.

Prior to Use:

1. Visual Inspection before use — confirm transparency of tube and absence of particles inside tube or damage to tube.

2. Perform airway kink test — do not use if tube kinks when flexed up to but not beyond 180 degrees

3. Test inflation and deflation of cuff— do not use if cuff walls reinflate immediately and spontaneously, even if only slightly. Do not use if cuff leakage is present or uneven bulging of the cuff or if inflation indicator balloon is spherical or irregularly shaped.

4. Prior to insertion deflate cuff into smooth “spoon shape” without any wrinkles on the distal edge —important for proper positioning and facilitates insertion.

Standard Insertion Technique:

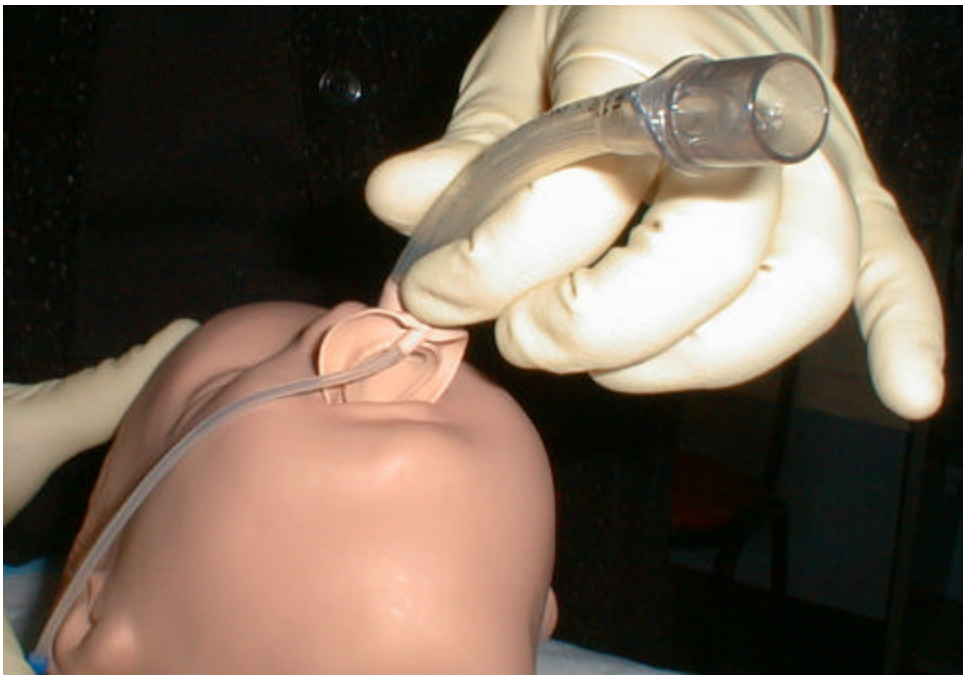
1. Lubricate posterior surface with a water-soluble lubricant — K-Y jelly. Do not use silicone-based lubricants.

2. Pre-oxygenate and monitor patient.

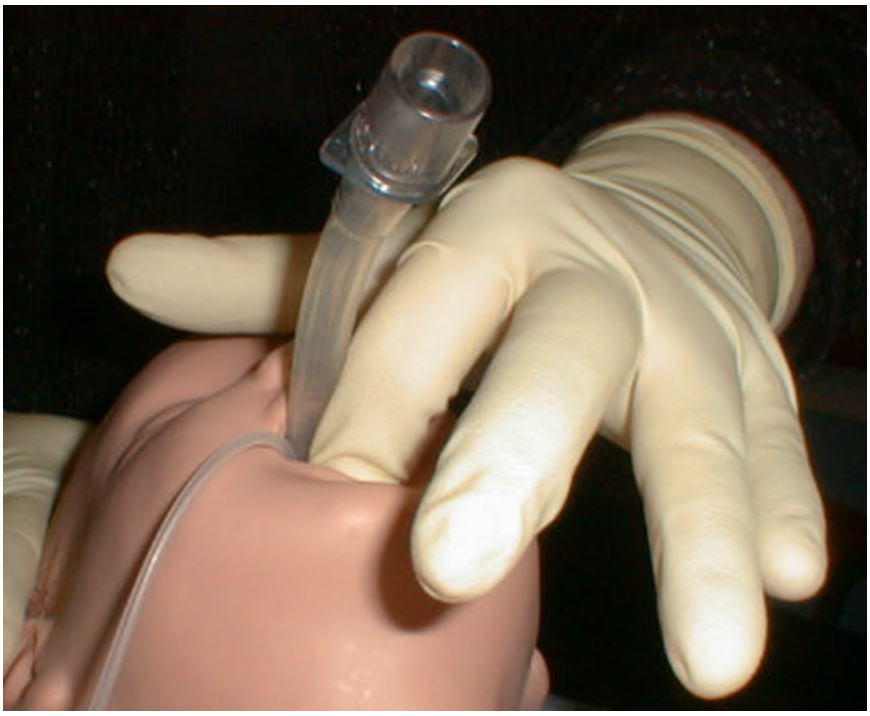
3. Hold the LMA like a pen. The mask aperture must face forward and the black line on the airway tube faces toward the nose.

4. Under direct vision, press the tip of the cuff upward against the hard palate and flatten the cuff against it.

5. Using the index finger to guide the LMA, press backwards toward the ears in one smooth movement. **Do not** use force.



6. Advance the LMA into the hypopharynx until a definite resistance is felt.
7. Gently maintain pressure on the tube while removing the index finger.



8. Inflate the cuff with just enough air to obtain a seal. The mask sits in front of the laryngeal opening and the cuff fills the recess of the hypopharynx immediately above the esophageal sphincter when inflated. Frequently,

only half of the maximum volumes are sufficient to achieve a seal. Never over inflate the cuff.

9. Check airway patency by inflating lungs and auscultating breath sounds. Confirm adequate air exchange by an alternative method such as $C0_2$ detector.
10. Tape and secure with a bite block.

AIIA 2000 Guidelines Emphasis:

1. More secure and reliable means of ventilation than a facemask
2. Does not protect against aspiration but regurgitation less likely than with BVM. Aspiration is uncommon with LMA.
3. Equivalent ventilation to ET tube.
4. Training and use is simpler than tracheal intubation.
5. Some patients cannot be ventilated with LMA and require alternative method.
6. Regular practice is indicated to minimize complications and optimize success rate.

Distributed by:

LMA North America
San Diego, CA 92121
800-788-7999

Nebulizer Therapy and Metered Dose Inhalers

Basic Material – Administering a Saline Mist Nebulizer

1. For croup, a saline mist nebulizer without any medication may be prepared for children requiring a cool mist treatment.

2. Use several cc's of saline in the aerosol chamber and deliver with at least 6 liters/minute continuous flow of oxygen.

3. Administer by blowby technique or with a mask as above.

Advanced Material – Nebulizer Therapy

1. Indicated in children with respiratory distress from a lower airway disease such as asthma.

2. Obtain a heart rate and respiratory rate prior to administering the nebulizer. If the child's heart rate exceeds the normal limits for age, notify the physician.

3. Assess respiratory status, including level of consciousness, work of breathing, and breath sounds, before and after the nebulizer treatment.

4. Dilute the medication with normal saline to a total volume of 3 ml.

5. Deliver with at least 6 liters/minute continuous flow of oxygen.

6. Encourage the parent or caregiver to hold the infant or child in his or her arms to facilitate administration of the nebulizer and reduce anxiety.

7. Administration by a loosely applied face mask or by blow by technique is appropriate for infants to preschool-aged children. If the infant or child is unable to tolerate the mask secured to the face, hold the mask close to the child's face or toward the child's nose and mouth.

Basic Material – Assisting with Metered Dose Inhalers

1. Should always be used with an aerosol chamber or spacer.
2. Allow several breaths between medication delivery puffs.
3. If the child is too young or is unable to trigger the aerosol effectively, use with a spacer and a mask attached. It may require two persons to secure the mask and deliver the medication.
4. Assess the child's respiratory status, including level of consciousness, work of breathing, and breath sounds, before and after delivery of medication.

ADDITIONAL PEDIATRIC REFERENCE INFORMATION INCLUDING INTERNET RESOURCES

Airway Management of the Pediatric Patient (videotape). Irving, TX: National American College of Emergency Physicians; 1994.

Aijian P, Tsai A, Knopp R, et al. Endotracheal intubation of pediatric patients by paramedics. *Ann Emerg Med* 1989; 18:489-494.

American Heart Association, Guidelines 2000 for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care. *Circulation,* 2000; 102 (supplement).

American Heart Association. *Textbook of Pediatric Advanced Life Support.* Dallas, TX: American Heart Association; 1997.

Bhende MS, Thompson AE, Orr RA. Utility of an end-tidal carbon dioxide detector during stabilization and transport of critically ill children. *Pediatrics* 1992; 89:1042-1044.

Brownstein D, Shugerman R, Cummings P, Prehospital endotracheal intubation of children by paramedics. *Ann Emerg Med* 1996; 28:34-39.

Kellner JD, Ohlsson A, Gadomski AM, et al. Efficacy of bronchodilator therapy in bronchiolitis –a meta-analysis. *Arch Pediatr Adolesc Med* 1996; 150:1166-1172.

Washington Emergency Medical Services for Children Project. Respiratory Distress in Infants and Children (videotape). Seattle, WA: Emergency Services, Children's Hospital and Regional Medical Center; 1990.

Internet Sites:

American Academy of Pediatrics, www.aap.org

American Academy of Pediatrics, Pediatric Education for Prehospital Professionals, www.PEPPsite.com

Emergency Medical Services for Children Program, www.ems-c.org

SELF STUDY MODULE POST TEST

Instructions:

There are two posttests included; one for the basic EMT only and an additional one for advanced level providers. The basic EMT should complete only the first basic test. Advanced level EMTs and Paramedics should complete both tests.

The following tests were developed in conjunction with the material presented in the self study module "Core Objectives and Core Reading Material" and the accompanying "Related Pediatric Procedures". Please read each question carefully, and select the one best response.

To Receive CME Credit:

Please forward your completed tests to the regional EMS office serving your area:

Interior Region EMS Council, Inc.
3522 Industrial Ave.
Fairbanks, AK 99701

Southern Region EMS Council, Inc.
6130 Tuttle Place
Anchorage, AK 99507

Southeast Region EMS Council, Inc.
P.O. Box 259
Sitka, AK 99835

BASIC EMT POST TEST -Airway Management and Respiratory Distress Module

1. Bacterial upper airway infection or epiglottitis is characterized by:

   a. Drooling, high fever, and a sudden onset of illness
   b. Drowsiness, and a sudden onset of illness
   c. Cough, low grade fever, and a slow onset
   d. Stridor, and a slow onset

2. A 24 month old alert child with a recent history of a cold for several days has a barky cough, hoarse cry, and slight intercostal retractions. Your initial treatment should include:

   a. Providing assisted ventilations with a BVM
   b. Blow by O_2 and providing cool mist
   c. Providing 100% O_2 via non rebreather mask and starting an IV
   d. Starting an IV and assisting ventilations with a BVM

3. Visible signs of respiratory distress in a child include:

   1. Sternal retractions
   2. Abdominal breathing
   3. Excessive drooling
   4. Inspiratory stridor
   5. Central cyanosis

   a. 1,2,3
   b. 2,3,4
   c. 1,4,5
   d. 1,2,4
   e. 3,4,5

4. Croup is characterized by;

   a. Crying, drooling, and a sudden onset
   b. Dry mucous membranes and a slow onset
   c. Cough, stridor, and a slow onset
   d. Fever, foul-smelling discharge, and a sudden onset

5. An abnormal lung sound heard during exhalation, which is caused by obstruction of bronchial tubes by swelling or spasm is called?

   a. Stridor
   b. Wheezing
   c. Crackles
   d. Snoring

6. Which of the following, observed during the initial survey, is indicative of partial obstruction of the upper airway?

   a. Stridor
   b. Nasal flaring
   c. Sniff position
   d. Cyanosis

7. Which of the following statements about pediatric anatomy is CORRECT?

   a. The smallest diameter of the trachea is the glottic opening
   b. The larynx is very posterior and encourages foreign body obstructions
   c. If the head is hyperextended the chance of airway obstruction is minimal
   d. The narrowest part of the pediatric airway is at the cricoid ring below the vocal cords

8. A 5 year old child appears to be struggling to breathe. She is cyanotic, lethargic, and is lying with her mouth open and tongue extended. Her ventilatory efforts are minimal at a rate of about 40. Her mother says she became ill earlier in the day with what she thought was a strep throat. What should your interventions include??

   a. Offer the child some water and see if she can swallow
   b. Visualize the posterior pharynx using a tongue blade to look for signs of strep throat
   c. Do nothing except transport the child to the hospital
   d. Initiate bag/valve/mask assisted ventilation with 100% oxygen and transport

9. Which of the following conditions would have the symptom of stridor without fever?

   a. Croup
   b. Epiglottitis
   c. Both croup and epiglottitis
   d. Foreign body aspiration

10. Which of the following methods to open the airway is NOT recommended for pediatric patients??

   a. Oropharyngeal airway
   b. Jaw thrust
   c. Hyperextension of the head
   d. Small pad under the shoulders

11. When managing the infant in respiratory distress, anatomic features to remember are:
    1. Head size when compared to body size is proportionately larger in the infant than the adult.
    2. The tongue is smaller than the adult's and should not cause a problem.
    3. The face is smaller with a flatter nasal bridge.
    4. Compression of the tissue under the chin may cause airway obstruction.
    5. Hyperextension of the neck may prevent airway obstruction.

    a. 2,3,4 c. 1,3,4
    b. 1,2,5 d 2,4,5

12. Foreign bodies and edema easily obstruct the pediatric airway because of which of the following?

    a. The position of the larynx
    b. The position of the trachea
    c. The small diameter of the airway tubes
    d. The soft, collapsible nature of the components of the airway

13. Which of the following signs would alert you that an asthma attack is progressing to respiratory failure??

    a. Auscultation of inspiratory and expiratory wheezing
    b. Vomiting and cyanosis
    c. Use of accessory muscles to breathe
    d. Diminished breath sounds and wheezing with prolonged expiration

14. You are responding to a 3 year old child who was playing and suddenly experiences coughing, choking and apnea. On arrival you see abdominal heaving but no air coming from mouth or nose. The child is extremely blue-gray and in obvious distress. What should you do??

    a. Attempt bag/valve/mask ventilation while obtaining a history
    b. Quickly perform the Heimlich maneuver
    c. Perform alternating back blows and chest compressions
    d. Survey the scene and question the caregiver regarding fever or other illnesses

15. Which of the following statements about BPD, bronchopulmonary dysplasia, is NOT true??

    a. It is caused by the therapies used to treat prematurity
    b. It is a viral syndrome
    c. BPD infants often have other congenital abnormalities
    d. BPD infants are more fragile and decompensate faster than other infants

ADVANCED EMT/PARAMEDIC POST TEST Airway Management and Respiratory Distress Module

1. When selecting the appropriate size endotracheal tube for a child, you should choose one that:

    a. Is the same size as the patient's age
    b. Is as long as the distance between the corner of the mouth and the ear lobe
    c. Fits tightly into the external nares
    d. Is the same diameter as the child's little finger

2. What is the correct method of primary confirmation of proper placement of an endotracheal tube?

    a. Palpate for chest rise and fall over the anterior chest and abdomen
    b. Observe for gastric distension, which indicates leakage of air around the tube in the trachea.
    c. Auscultate the anterior chest and midabdominal area for the presence of bubbling or gurgling sounds.
    d. Auscultate for bubbling or gurgling sounds over the epigastrum and for breath sounds at the midaxillary regions and both left and right anterior chest.

3. Which of the following is NOT a typical pathological problem found in asthma?

    a. Mucosal edema of the membranes lining the air passages
    b. Spasm and bronchoconstriction of the lower airway passages
    c. Swelling of the subglottic structures and tissues
    d. Excess mucous secretions

4. A 6 year old has had an asthma attack for about 2 days. He was seen earlier in the day in the clinic and treated with epinephrine. Now about 12 hrs later you find him confused, agitated and cyanotic. You cannot auscultate any breath sounds. His vital sounds are: BP 102/78, P 160, RR 12.
   Select the appropriate treatment:

    a. Give O_2 per mask at 12 liters; start an IV of LR and run at 20cc/min; obtain a temperature and transport.
    b. Initiate ventilatory support per bag/valve/mask and immediately transport
    c. Administer O2 per mask, attempt to have him drink warm water and have him use his inhaler once more
    d. Begin CPR and contact the hospital

5. In the field, it is important to start an IV in a two year old child who has significant respiratory stridor, appears agitated, and is clinging desperately to mom??

   a. TRUE
   b. FALSE

6. Accidental extubation most commonly occurs in which of the following situations?

   a. During CPR
   b. During loading or unloading from ambulances
   c. When turning a child
   d. When placing leads for a cardiac monitor

7. Which of the following is an acceptable means of <u>secondary</u> ET tube placement confirmation??

   a. Observing for improvement in color
   b. Monitor for increase in heart rate
   c. Use of a CO2 detector in pulseless patients
   d. Use of an esophageal detector bulb in children weighing more than 20 kg.

8. A common complication of both bag/valve/mask and endotracheal intubation is??

   a. Acid/base imbalance
   b. Insufficient inflation of both lungs
   c. Gastric distension
   d. Hyperventilation

9. Insertion of an LMA airway uses a blind insertion technique, which inserts the cuff into the trachea.

   a. TRUE
   b. FALSE

10. ET tube intubation should be considered in a responsive child in respiratory distress with significant retractions and wheezing who is not responding to high flow oxygen therapy via mask.

    a. TRUE
    b. FALSE